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(56) Documents cited
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(54) Automatic dishwasher

(57) In an automatic dishwasher, a washing cycle includes alternating periods of high and low jet strength. The periods of low jet strength give rise to less acoustic noise from the dishwasher. The jet strength may be varied by regulating pump speed, operating a solenoid-controlled valve regulating flow of wash liquid to the jet orifices, or by employing either one of two sets of jet orifices differing in size.

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.

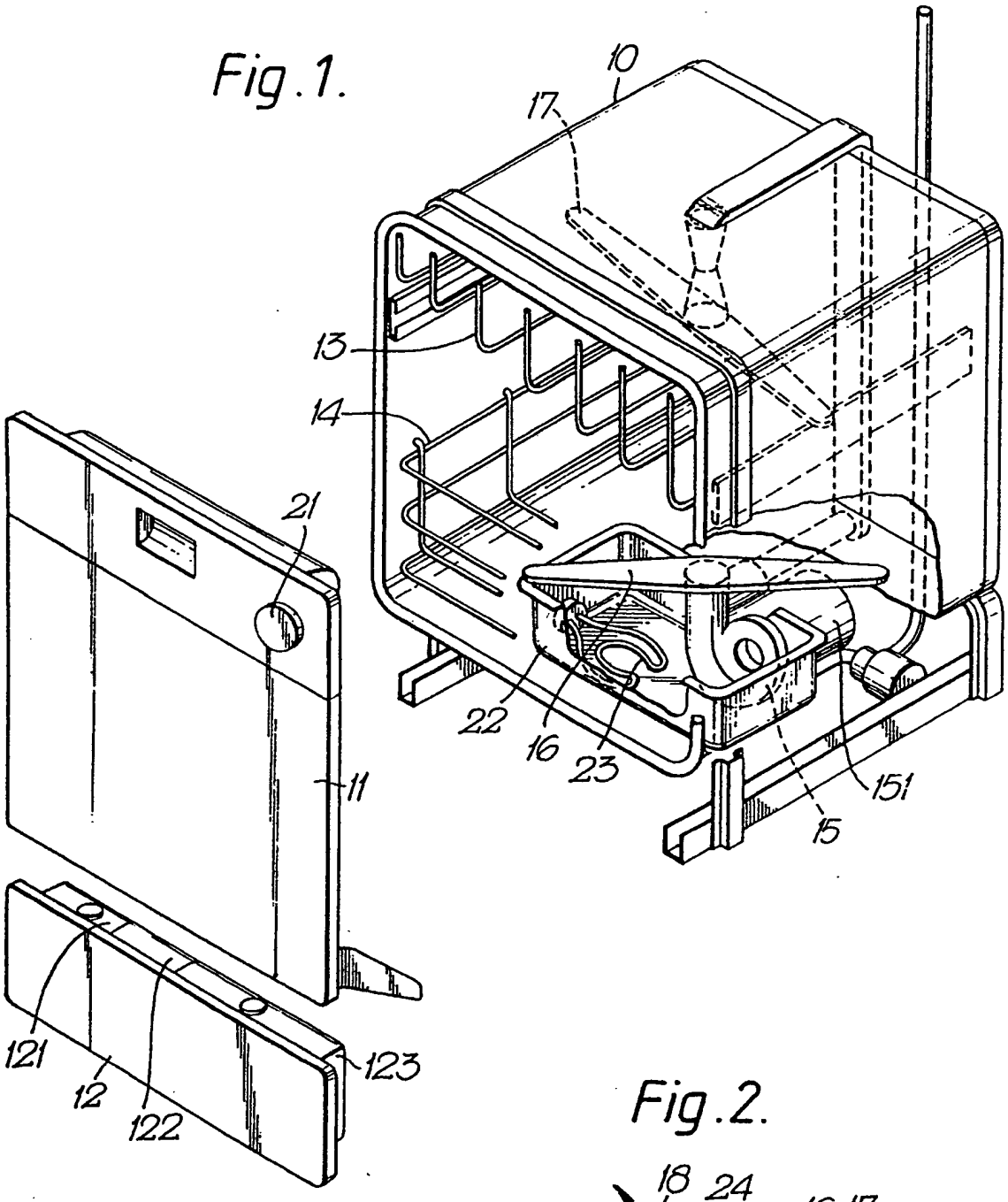
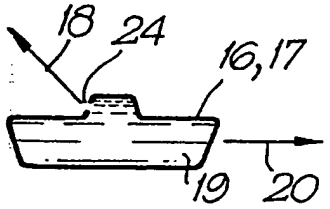


Fig.2.



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Automatic Dishwasher

This invention relates to automatic dishwashers, in which several jets of a liquid are directed onto the soiled surfaces of articles stacked within an enclosure, and the washing operation is controlled automatically.

A major disadvantage of dishwashers is that the acoustic noise they produce during a washing cycle is particularly intrusive; dishwashers are usually fitted into a kitchen. Some of the noise is probably derived from vibrations of the centrifugal pump commonly used to circulate the washing liquid, but it is believed that a major part of the noise is generated by the vigorous liquid jets as they impact the lining of the enclosure, either directly or upon deflection from the articles being washed. The purpose of the present invention is to minimise this problem.

The invention provides an automatic dishwasher comprising means for directing several jets of liquid onto the soiled surfaces of articles stacked within an enclosure, and means for periodically varying the strength of the jets, and thus the force exerted by the jets as they impinge on the soiled surfaces, between a high strength sufficient to displace loosened particles from the soiled surfaces, and a lower strength sufficient to maintain a flow of the liquid over the soiled surfaces to soak them, the or each period at the high strength being substantially shorter than at the lower strength.

The acoustic noise, which depends on the strength of the jets, is therefore reduced for a substantial proportion of the total

washing cycle, the usual level of noise being suffered only during the brief periods of high jet strength. The periods at high jet strength, which may for example be of between thirty seconds and two minutes' duration, preferably alternate with the periods at the lower jet strength, which may be of between four and five minutes' duration. This is expected to be much less intrusive than with previous washing cycles which have used a constant, high jet strength.

The means for varying the jet strength may operate to vary the total bulk flow rate of the liquid in all the jets, and/or to vary the speed of the liquid flow in the jets. Preferably, the jet directing means comprises a liquid pump for circulating the liquid within the enclosure, and the jet strength varying means controls the speed of the pump. This has the additional benefit of reducing acoustic noise from the pump at the same time that the noise from the liquid jets is reduced.

Alternatively, the jet strength varying means may comprise means for selectively constricting the flow of pumped liquid to jet orifices from which the jets emerge, for example using a solenoid-controlled valve operated from a central control.

A further alternative is to provide two alternative arrays of jet orifices each connectable for the supply of the liquid under pressure to produce the jets, the orifices of one array being larger or more numerous than those of the other, the jet strength varying means then comprising means for connecting selectively either array to the liquid supply.

The invention also provides a method of controlling automatically an automatic dishwasher of the type described above, comprising periodically varying the strength of the jets as described above.

One way of using the invention in an otherwise conventional automatic dishwasher will now be described, by way of example only, with reference to the accompanying drawings, in which;

Figure 1 is an exploded diagrammatic perspective view from the front and the right hand side of an automatic dishwasher which may be controlled in accordance with the present invention; and

Figure 2 is a cross-section, to an enlarged scale, of an arm provided with jet orifices, the arm forming part of the dishwasher of Figure 1.

A dishwasher comprises a cabinet enclosure 10 with a door 11 which pivots forwardly about a horizontal axis to open. A panel 12 beneath the door supports separate compartments 121, 122 and 123 respectively for rinse aid, softening crystals and salt. An upper basket 13 and a lower basket 14 are mounted within the cabinet 10 for the stacking of soiled articles.

Liquid which collects in a sump 22, and which may be heated by an electric heater element 23, is recirculated by means of a main pump 15 driven by a permanent split capacitor motor 151 of two pole construction. Liquid from the pump 15, which has an impeller rotating at 2,700 rpm to produce a 3.6 metre working head delivering 105 litres per minute, is fed to a lower spray arm 16 and an upper spray arm 17 by way of rotating joints.

Each spray arm 16, 17 has a regularly-spaced array of jet orifices for producing jets of the liquid which are directed onto the stacked articles in the baskets 13, 14. In this example, each spray arm has five such jet orifices, arranged at the centre, i.e. on the axis of rotation of the arm, at each end, and midway between each end and the centre. One of these jet orifices 24 is shown more clearly in Figure 2, which is a cross-section to an enlarged scale through one of the spray arms 16, 17. Liquid 19 is forced under pressure through the orifice 24 to emerge as a jet 18 at an acute angle to the horizontal plane of rotation of the spray arm. In this example, this angle is approximately 45°, and is the same for all the orifices on the spray arm. Clearly, the jets 18 of the lower spray arm are directed upwards and those of the upper spray arm are directed downwards. The jets 18 produce a horizontal reaction force 20 which drives the spray arm about its rotational axis.

The automatic dishwasher is controlled from an electric timer unit 21 connected to the door panel 11. The electric timer at 21 is set by manual operation of a control disc, and has a cam disc which turns slowly during the cycle of operation to control the

sequence of operation of all the elements of the dishwasher.

The rotational speed of the motor 151 is capable of being reduced from its maximum speed of 2,700 rpm to a lower speed of 2,000 or 2,100 rpm. In this example, this is achieved by means of a voltage transformer, the electric timer control 21 causing the electrical supply to be switched between high and low voltages. Clearly, other conventional ways of alternating the pump speed could be employed.

A further pump (not shown) is provided for emptying the liquid from the enclosure at the end of a washing cycle.

The operation of the dishwasher will now be described. The sump 22 is filled with mains water by the opening of a fill valve (not shown) under the control of the timer 21. When the water has reached the correct level, as sensed by a pressure switch, the fill valve is closed and the electric timer 21 then causes the pump 15 to start at its lower speed of 2,000 rpm or 2,100 rpm. This causes jets of the cold water to soak into the layers of food waste on the surfaces of the articles stacked within the enclosure in order to soften them. The water is recirculated as it collects in the sump 22, and this process continues for at least 4 minutes. The timer 21 then causes the pump motor 151 to be switched to the higher voltage level, to rotate at the higher speed of 2,700 rpm for a substantially shorter period, in this example 2 minutes. This is intended to dislodge most of the softened matter from the surfaces of the articles. The timer 21 then stops the pump, and switches on the emptying pump to pump out the contents of the enclosure.

The next phase uses hot water and the detergent powder in order to soften and remove any remaining material soiling the surfaces of the articles. The sump 22 is refilled with water, and heated by the electric heater element 23. While the water is being heated, the pump is operated at its lower speed for the longer period, which will be at least four minutes thus softening the outer layers of food waste, and then at its full speed for the shorter period, say two minutes, to dislodge the softened material. This cycle is then repeated as many times as is necessary for an adequate main wash period which will probably be about twenty minutes long.

At an early stage, preferably during the first phase at full pump speed, the timer 21 opens a flap (not shown) to release the detergent powder from the compartment 123 which is mixed with the circulating water. The water is heated during the first ten minutes or so to reach a pre-set temperature, at which it is maintained for the remainder of the main wash cycle. At the end of the main wash cycle, the detergent solution is pumped out.

The third phase of operation is the rinse cycle, of approximately ten minutes' duration, the time taken to heat the water to the pre-set temperature. The sump 22 is once again filled with cold water, and heated as the pump speed is alternated between its full speed and its reduced speed. During this rinse phase, the timer 21 opens a valve (not shown) to release the rinse aid (a surfactant) from its compartment 121. At the end of the rinse phase, the hot liquid is pumped out, leaving the washed articles sufficiently hot that they then dry in the empty enclosure, usually assisted by a circulation of air which may be heated.

Although in this example the strength of the liquid jets is controlled by varying the pump speed, which will have the effect both of reducing the bulk liquid flow and also the jet velocity, it will be appreciated that other ways of changing the jet strength may be used. The jet velocity must be sufficient for it to reach the articles stacked within the enclosure, and one way of maintaining the jet velocity while reducing the bulk flow rate would be to reduce the cross-sectional areas of the jets while maintaining the pressure of liquid within the spray arms. This could for example be achieved by diverting the pumped liquid to an alternative array of jets which have smaller jet areas. This alternative array could be on the same or a different spray arm.

Further, the electric timer 21, which in this example comprises a synchronous motor driving a cam body through a reduction gear mechanism for providing a programmed sequence of operations, may be replaced by a programmed microprocessor controlled by a manually-operable switch in the cabinet door 11.

CLAIMS

1. An automatic dishwasher comprising means for directing several jets of liquid onto the soiled surfaces of articles stacked within an enclosure, and means for periodically varying the strength of the jets, and thus the force exerted by the jets as they impinge on the soiled surfaces, between a high strength sufficient to displace loosened particles from the soiled surfaces, and a lower strength sufficient to maintain a flow of the liquid over the soiled surfaces to soak them, the or each period at the high strength being substantially shorter than at the lower strength.

2. A dishwasher according to Claim 1, in which the means for varying the jet strength operates to vary the total bulk flow rate of the liquid in all the jets.

3. A dishwasher according to Claim 1 or Claim 2, in which the means for varying the jet strength operates to vary the speed of the liquid flow in the jets.

4. A dishwasher according to any preceding Claim, in which the jet directing means comprises a liquid pump for circulating the liquid within the enclosure, and the jet strength varying means controls the speed of the pump.

5. A dishwasher according to any of Claims 1 to 3, in which the jet directing means comprises a liquid pump for circulating the liquid within the enclosure, and the jet strength varying means comprises means for selectively constricting the flow of pumped liquid to jet orifices from which the jets emerge.

6. A dishwasher according to any of Claims 1 to 3, comprising two alternative arrays of jet orifices each connectable for the supply of the liquid under pressure to produce the jets, the orifices of one array being larger or more numerous than those of the other, and in which the jet strength varying means comprises means for connecting selectively either array to the liquid supply.

7. A method of controlling automatically an automatic dishwasher having means for directing several jets of liquid onto the soiled surfaces of articles stacked within an enclosure, comprising periodically varying the strength of the jets, and thus the force

exerted by the jets as they impinge on the soiled surfaces, between a high strength sufficient to displace loosened particles from the soiled surfaces, and a lower strength sufficient to maintain a flow of the liquid over the soiled surfaces to soak them, the or each period at the high strength being substantially shorter than at the lower strength.

8. A dishwasher according to any of Claims 1 to 6, or a method according to Claim 7, in which the or each period at the high jet strength is controlled to be less than two minutes.

9. A dishwasher according to any of Claims 1 to 6 and 8, or a method according to Claims 7 or 8, in which the or each period at the high jet strength is at least thirty seconds.

10. A dishwasher according to any of Claims 1 to 6, 8 and 9, or a method according to any of Claims 7 to 9, in which the or each period at the lower jet strength is at least four minutes long.

11. An automatic dishwasher substantially as described herein with reference to the accompanying drawings.

12. A method of controlling an automatic dishwasher, substantially as described herein with reference to the accompanying drawings.

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